

self in opposition to Darwin, Wallace, Fritz Müller, Weismann, and most of those whose labours have contributed to the establishment of the theory of evolution. But in speaking of views which he does not himself hold, he repeatedly allows himself to use language which is highly unbecoming in a scientific man. This is especially noticeable in his remarks on the subject of mimicry. We are of course prepared to find that he does not believe in it, but it might be thought that a view which commended itself to Bates, Wallace, F. Müller, and Trimen, to say nothing of Darwin himself, was at least deserving of respectful treatment. M. Piepers does not think so, and his language on the subject is so uncontrolled as to suggest doubts whether, in spite of his training as a jurist, he can be considered a fair and competent examiner of evidence. It is easy enough to throw about words like "Aberglaube" and "Humbuglehre" in reference to the views of other workers, and to suggest that opponents are "mentally abnormal"; but such expressions recall the methods of the advocate rather than of the judge, and they render their employer liable to severe retaliation, did any one care to administer it.

A conspicuous instance of this want of restraint occurs in the note on p. 279; where the author altogether overreaches himself in his denunciation of Schröder. It is not our business to correct his literary blunders, but we cannot help thinking that the original utterer of the famous line "*homo sum; humani nil a me alienum puto*" (misquoted, by the way) would be somewhat surprised to see himself referred to as "the old philosopher." This, however, may pass; more open to question is the wisdom of introducing the quotation at all. M. Piepers seems to think that the upholders of mimicry will be "angry" at his strictures. They are more likely to be amused, and perhaps a little saddened, for there is always an element of pathos in resistance to the inevitable.

Protective resemblance, in relation to selection, fares no better with the author than mimicry itself. Thayer's demonstration of the protective value of the pale underside of birds and mammals is convincing enough for most minds; Piepers simply dismisses it with the remark that he cannot admit it in the case of insects. One is tempted to ask him what he expected in the case of insects, but this dictum is a not unfair specimen of his critical method generally. It is difficult to answer a disputant who holds (p. 250) that the resemblance to forms of vegetation shown by the underside of *Euchloe cardamines* and even of *Kallima paralecta* is accidental. The somewhat unseemly comparison on the same page is perhaps meant for a joke. If so, it says very little for the author's humour; if not, it says even less for his logic.

The treatment of seasonal forms affords another instance of his curious reluctance to accept the plain and obvious explanation of certain facts, if that explanation involves a recognition of the principle of selection. Some of his remarks on the varying forms of Malayan butterflies have all the interest and importance which naturally belong to the personal observations of a good field naturalist, but it is strange to find him still advancing theories of the direct influence of local conditions which were long ago discarded by Wallace. The truth which underlies his statements is probably this—that polymorphism gives an opportunity to selection, under

which influence it may become limited by locality and season. In his discussion of the permanent or variable whiteness of certain animals, he cannot of course shut his eyes to the fact that the same visual effect of whiteness is produced in different cases by different means. He remarks in a somewhat puzzled way that there is nevertheless evidently some connection between the whiteness caused by a white pigment (so-called) and that due to scattered reflection. Of course there is, or may be, such a connection; but the obvious key to the mystery, viz. selective adaptation, is not even noticed by him.

It is really pitiful to witness the straits to which those evolutionists are reduced who desert the firm and clear lines laid down by Darwin. Towards the end of his treatise M. Piepers makes a certain appeal for the indulgence due to an amateur. We are inclined to admit his claim, and to judge him leniently on that account. Courage and candour he does not lack, and it is deplorable that having tasted the "Pierian spring," he has not taken a deeper draught of its waters. A little more reading would have shown him that many of his discoveries had been already made, and that most of his difficulties had been answered by anticipation.

F. A. D.

PROFESSOR TAIT'S COLLECTED PAPERS.

Scientific Papers. By Peter Guthrie Tait, M.A., Sec.R.S.E., &c. Vol. i. Pp. xiv + 498. (Cambridge University Press, 1898.)

THE Cambridge Press has already laid mathematical and physical workers under deep obligations by its editions of Maxwell, Stokes, Thomson, and Cayley. It now proposes considerably to extend these obligations, and as an instalment of their fresh enterprises we have here the first volume of the collected papers of Prof. Tait. This reprint appeals to readers of widely different interests, and will be welcomed by all, not only on account of the highly specialised investigations of various kinds which it contains, but also as a monument to a writer to whom science owes a great deal.

It would be out of place, even if the reviewer were competent, to attempt any detailed examination of the papers here presented. They have been before the world for many years, and their value and originality have not been contested. A rapid sketch of the contents may, however, be given. A large proportion of the book is taken up with the quaternion investigations in which Prof. Tait first made his mark, and to which he has returned from time to time with undiminished enthusiasm. The precise scope and value of the quaternion method are questions on which opinions have greatly differed, and the number of mathematicians otherwise eminent who could be reckoned as fully concurring in Prof. Tait's views on these points is probably very limited. In this country there has been a certain natural diffidence, and perhaps a little want of courage, which have hindered the free expression of opinion; but on the continent the assertion has been made again and again that the subject has in some respects been unfortunate in its expositors, and that the elements of undoubted value in the theory have been unduly discredited by the somewhat excessive claims made on its behalf. It is possible to sympathise

with this view, and yet to attach very high importance to the investigations now in evidence. They are concerned mainly with the processes of differentiation and integration as applied to quaternions, and especially with the properties of Hamilton's operator

$$i\frac{d}{dx} + j\frac{d}{dy} + k\frac{d}{dz},$$

a branch of the subject which (as is well known) has exercised a great fascination on many distinguished cultivators of mathematical physics, from Maxwell downwards. That Prof. Tait's papers remain the primary, and indeed almost the sole, authority on such matters, is ample warrant for the present republication. For the rest, a few items gathered from the titles, such as Fresnel's Wave-Surface, the Theory of Electrodynamics, the Theory of Strain, the Dynamics of Rotation, Green's Theorem, Isothermal Surfaces, and Minding's Theorem, will indicate the variety and importance of the subjects which Prof. Tait has sought to bring within the range of this ambitious calculus.

Passing from this group, we have to notice an elaborate investigation on "Knots," suggested originally by Thomson's theory of vortex-atoms. It deals with a branch of the Geometry of Position which few mathematicians (and those only of the ablest) have ventured to touch; and although the presentation disclaims any finality, there can be no doubt that Prof. Tait's investigations must be accounted a solid and valuable, as they are an interesting contribution to the subject.

It would be ungrateful to pass over a number of minor papers which are specially characteristic of Prof. Tait in respect of the symmetry and elegance of the mathematical treatment, or of the manner in which new light is thrown on well-worn topics. Of these the papers on Hamilton's Characteristic Function, and on the Hodograph, may be cited as specimens. In this latter we find the now well-known representation of a small oscillation in a resisting medium as the projection of motion in an equiangular spiral, as well as several other results or modes of proof which have long become common property. It is pleasant to be reminded of their real source.

A very attractive topic is treated alike with originality and elegance in the paper on "Mirage."

There remain the experimental papers. Of these it may be sufficient to here say that those on Thermo-Electricity have long ranked as classics; and that the paper on the pressure-errors of the *Challenger* thermometers is an interesting record of a laborious investigation undertaken to decide a very important practical question.

Some readers may perhaps be disappointed to find that one side of Prof. Tait's activity is not represented in these pages. He has in his time been engaged in many keen controversies, in which he has displayed the qualities of a "first-class fighting man." One cannot but feel, therefore, great admiration for the restraint he has shown in omitting all traces of such incidents from the present record of his work. There is, in fact, only one paper which one would willingly have spared, and that for quite other reasons. The lecture on "Force," with its insistence on what after all are verbal questions, is surely out of place in the present collection. The readers who are capable of following the *technique* of quaternions, or the

intricacies of amphicheiral knots, do not need to be lectured on the looseness of newspaper language; whilst the grave discussion as to whether force or energy has the greater title to rank as a "thing" will hardly excite in them any other feeling than the amusement which (one suspects) may have been the real object of the whole discourse.

The printing and general appearance of the volume are beyond praise. One might, indeed, protest that the *format* is a little *too* luxurious. Many persons hold to the view that the octavo form adopted in the cases of Stokes and Thomson is far more handy and convenient for real work than the more imposing quarto. In the case of Cayley, the larger form was perhaps required by the nature of the subject-matter, with its long algebraical formulæ; but there is little in the present collection which could not with a little ingenuity have been accommodated in the smaller page. But such criticisms are, after all, somewhat ungracious. We conclude by thanking the University and Prof. Tait for this very acceptable volume, which we trust to see speedily followed by a second. And we venture to suggest to the University Press that an additional and welcome element of interest would be imparted to these reprints if they could be adorned with portraits of the authors, even when these are happily still amongst us.

HORACE LAMB.

OUR BOOK SHELF.

Elementary Physiology. By Benjamin Moore, M.A. With 125 Illustrations. Pp. vi + 295. (London: Longmans, Green, and Co., 1899.)

THIS book contrasts favourably with most others of its class. A small treatise of three hundred pages on elementary physiology can scarcely avoid being superficial, and, from the students' point of view, inadequate; but to these inevitable shortcomings there are too often added, in books of the kind, the quite gratuitous defects of inaccuracy in statement and failure to keep up with the advance of knowledge. From faults of the latter description the work before us is practically free, and it may be commended with confidence to the junior student, who, as the author says, "is often plunged into a mass of detail, and gets so involved in this, that he loses sight of the main outstanding features of the subject." Most teachers of physiology have probably had experience among their pupils of the mental condition here referred to. Lucid and concise in statement, Mr. Moore's book manages to convey a large amount of accurate information in very small compass. It bears ample evidence of being no mere literary compilation, but the production of a genuine worker in physiology, whose mode of treatment is often striking and original. As might be expected from the author, the book is especially strong in such matters as digestion, absorption and metabolism.

The volume is in most respects so meritorious that it seems ungracious to call attention to its blemishes. These are, as a rule, not serious. It would be unfair to find fault with a book of this kind for being dogmatic; it is plainly not a fitting place for the discussion of controverted questions. The statement, however, on p. 14, with respect to the relations of cartilage and bone is distinctly misleading. But with few exceptions the points that call for criticism concern the form of the book rather than its matter. Thus, the author is occasionally guilty of an awkwardness or inelegance of language that might easily have been avoided, and we cannot say that we approve of such colloquialisms as "harking back again to our simple type," or "that bigger supply of